HERC COVERAGE GUIDANCE

Coronary Computed Tomography Angiography (CCTA) is not recommended for coverage.

RATIONALE FOR GUIDANCE DEVELOPMENT

The HERC selects topics for guideline development or technology assessment based on the following principles:

- Represents a significant burden of disease
- Represents important uncertainty with regard to efficacy or harms
- Represents important variation or controversy in clinical care
- Represents high costs, significant economic impact
- Topic is of high public interest

Coverage guidance development follows to translate the evidence review to a policy decision. Coverage guidance may be based on an evidence-based guideline developed by the Evidence-based Guideline Subcommittee or a health technology assessment developed by the Heath Technology Assessment Subcommittee. In addition, coverage guidance may utilize an existing evidence report produced by one of HERC’s trusted sources, generally within the last three years.

EVIDENCE SOURCES


National Institute for Health and Clinical Excellence (NICE). (2010). *Chest pain of recent onset: Assessment and diagnosis of recent onset chest pain or discomfort of suspected
Coronary computed tomographic angiography (CCTA) is a diagnostic imaging test that uses a computed tomographic (CT) scanner to non-invasively image the coronary arteries of the heart. Since obstructive coronary artery disease (CAD) is common in the United States (US) adult population and is responsible for most of the heart attacks, the ability to identify stenosis of the coronary arteries in patients with chest pain becomes important. Coronary computed tomographic angiography can be used in place of other intermediate tests such as stress electrocardiogram (ECG), stress nuclear perfusion imaging and stress echocardiography (ECHO) to either increase or decrease the likelihood of CAD as the cause of chest pain. In contrast to CCTA which provides anatomic information about the coronary arteries, these tests evaluate myocardial ischemia (indicators that the heart muscle is not receiving adequate blood flow).

The development of multi-slice CT scanners has led to increased use of CCTA with nearly half of all cardiology practices in the US leasing or owning cardiac CT equipment. Advocates of CCTA recommend it for patients with low to intermediate risk of CAD who present with acute onset of chest pain [primarily in the emergency department (ED) setting] and with stable chest pain suggestive of CAD (primarily in the outpatient setting). Additionally CCTA is being advocated for patients with high risk of CAD and atypical chest pain, evaluation of patients with symptoms after coronary stent placement and screening of asymptomatic patients with high risk of CAD. Both patient selection criteria and equipment capabilities affect the diagnostic efficacy of CCTA. Radiation dose and financial costs for CCTA are significant.
Evidence Review

MED Report (Clark 2011)

Patient and technical factors affect the use and quality of CCTA. Patients selected for CCTA: 1) should not be obese; 2) should not have arrhythmias or heart rates more than 65 beats per minute; 3) should be able to hold their breath for more than 20 seconds; 4) should be able to tolerate a standard dose of contrast material; and 5) should not have significant coronary artery calcifications. Multi-slice CT scanners should have at least 64 slices to perform CCTA adequately. The performance and interpretation of CCTA requires special training, and a minimum of 50 cases per year is recommended to maintain competence in the procedure.

Coronary computed tomographic angiography has a very high sensitivity (≥ 97%) and moderate to moderately high specificity (72-93%) for the detection of coronary artery stenosis, based on moderate quality evidence. A CCTA test sensitivity of 97% means it will detect almost all (97%) of those who have at least one obstructed coronary artery, and only miss 3% of such patients. Thus if the CCTA test is negative it will very likely be a "true negative" and the patients can be sent home. On the other hand, a CCTA test specificity of 72% to 93% means that in a population of patients without obstructive CAD, the test will only be negative 72% to 93% of the time. In the other 7% to 28% of patients without obstructive CAD, it will be a falsely positive test. Practically speaking, a positive CCTA test will often require further testing (invasive angiography) in order to determine if it is a true positive test or a false positive test. These results can be further influenced by the prevalence of obstructive CAD in the population on which the test is used, as described in the body of the report.

These performance characteristics support the use of CCTA to “rule out” obstructive CAD in ED patients with acute chest pain and normal ECGs and initial cardiac enzymes, and in outpatients with stable chest pain, a population with low to intermediate probability of obstructive CAD. Coronary computed tomographic angiography in these situations can be used to identify those patients with no CAD (i.e., negative CCTA in a patient with low to intermediate [pre-test] probability of CAD), so they can be safely discharged from the ED without further evaluation. This is substantiated by one small RCT (n = 197) and seven observational studies suggesting that ED patients with low to intermediate pre-test probability of CAD and a negative CCTA do not have increased cardiac events over the subsequent year.

In patients with low to intermediate risk of CAD, CCTA appears to have better diagnostic accuracy than stress ECG and stress nuclear perfusion imaging, based on low to moderate quality evidence. A single, poor quality, before and after study suggests that CCTA may reduce the number of subsequent tests including stress nuclear
perfusion imaging and invasive coronary angiography. A number of validated clinical prediction rules exist that clinicians can use to assess the [pre-test] probability of obstructive CAD prior to ordering a CCTA.

The MED report did not find studies that addressed screening asymptomatic patients, although they did not specifically search for such evidence.

The amount of radiation dose for CCTA is similar to a CT scan of the abdomen or an invasive coronary angiography, and is estimated to be 8-14 mSv. In addition to radiation exposure and contract reactions or nephropathy, the other potential harms of CCTA are incidental findings. There are relative benefits and harms from the incidental findings noted on CT of the chest (findings in the chest obtained during a CCTA). Approximately 40% to 80% of patients undergoing CCTA will have a finding that is not related to the coronary arteries; 5% to 20% will have a finding deemed clinically important enough for further evaluation. Although some of the patients with these incidental findings will have been judged to have received some benefit, findings from the few studies that have examined this question suggest that the proportion of patients receiving some benefit is very low, while additional risks, anxieties and costs are generated by the additional investigations.

**Evidence Source**

**NICE Guideline: Chest Pain of Recent Onset**

*Acute chest pain (evaluation in the ED)*

The NICE guideline does not recommend the use of CCTA as a first line test for evaluation of patients in the ED with acute chest pain. The guideline assessment of CCTA in this setting is as follows:

In the past few years a number of pilot studies have examined the utility of multislice CT in the ED in the differential diagnosis of acute chest pain. To date these studies consist of small numbers of patients (around 100 patients), they have been conducted primarily in the USA, and they are limited in scope because each represents the experience of one centre. There are differences in study protocols, patient recruitment, scanners used, angiography protocols and angiographic analyses. This makes direct comparison of these studies difficult with respect to reviewing and interpretation. The authors of these studies, while stating the potential promise of multislice CT, do emphasise that further evaluation needs to be done. There are other considerations as given below:

- Currently the use of multislice CCTA in the ED would reduce diagnostic time, however this becomes less important with the evolving technology of reduce waiting time for biomarker assay results.
- Multislice CCTA will identify a group of patients with sub clinical CAD i.e. disease that is not the cause of the current chest pain episode. The significance of this will need to be evaluated in large studies in the recruitment of unselected consecutive chest pain patients.

- It has not been established if the patient in the ED should receive a dedicated CT coronary angiogram, or have an entire thoracic scan. A dedicated CT coronary angiogram would give the best possible images of the coronary arteries, but allows limited visualisations of other structures that may be responsible for chest pain. The benefit of an entire scan is that it would rule out pulmonary embolism and aortic dissection, however, this would involve increased radiation dose, increased scanning time, and possible less than optimal visualisation of coronary arteries.

- The best use of the multislice CT scanner in the ED has not been established. Images could be obtained as soon as possible after initial assessment (history, risk factors, examination) and the first set of cardiac enzymes. In which case the multislice CCTA results would be used as a component of the decision to discharge or admit the patient. Alternatively multislice CCTA could be used to aid in determining what further monitoring and treatment is indicated after a decision has been made to admit the patient. Hence it is unclear at which point multislice CCTA would fit into an algorithm used in the ED, and what would be the most cost-effective use of multislice CCTA in the ED. This may have implications on cost-effectiveness.

- Current preliminary findings indicate that multislice CCTA in the ED has potential for the ruling out of CAD. When stenosis of > 50% is detected the patient would undergo further non invasive or invasive testing, but the precise course of further evaluation is uncertain at this stage due to the limited literature. Resolving this could potentially be a large piece of work, and would impact on the current care pathway.

- Owing to the limited number of studies, health economic evaluation of multislice CCTA in the ED may be difficult, particularly as there is no information regarding the subsequent testing of patients when stenosis is > 50%.
**Stable Chest Pain (outpatient evaluation)**

The NICE guideline makes the following recommendations pertaining to CCTA:

In people without confirmed CAD, in whom stable angina cannot be diagnosed or excluded based on clinical assessment alone, estimate the likelihood of CAD (see Table 1). Take the clinical assessment and the resting 12-lead ECG into account when making the estimate. Arrange further diagnostic testing as follows:

- If the estimated likelihood of CAD is 61–90%, offer invasive coronary angiography as the first-line diagnostic investigation if appropriate.
- If the estimated likelihood of CAD is 30–60%, offer functional imaging as the first-line diagnostic investigation.
- If the estimated likelihood of CAD is 10–29%, offer coronary artery calcium scoring as the first-line diagnostic investigation. If the calcium score is:
  - zero, consider other causes of chest pain
  - 1–400, offer 64-slice (or above) CCTA
  - greater than 400, offer invasive coronary angiography.

**Table 1. Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex and risk factors**

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Non-anginal chest pain</th>
<th>Atypical angina</th>
<th>Typical angina</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>35</td>
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<td>35</td>
<td>8</td>
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<tr>
<td>65</td>
<td>49</td>
<td>69</td>
<td>71</td>
</tr>
</tbody>
</table>

For men older than 70 with atypical or typical symptoms, assume an estimate > 90%.
For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.

Values are percent of people at each mid-decade age with significant coronary artery disease (CAD)¹.
Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).
Lo = Low risk = none of these three.
The shaded area represents people with symptoms of non-anginal chest pain, who would not be investigated for stable angina routinely.
Note: These results are likely to overestimate CAD in primary care populations. If there are resting ECG ST-T changes or Q waves, the likelihood of CAD is higher in each cell of the table.

¹ Adapted from Pryor DB, Shaw L, McCants CB et al. (1993) Value of the history and physical in identifying patients at increased risk for coronary artery disease. *Annals of Internal Medicine* 118(2), 81-90.

Coverage Guidance: Coronary Computed Tomography Angiography
Approved by HERC 8/8/2013
Discussion of the evidence for CCTA in the NICE guideline is summarized as follows:

**Advantages and Disadvantages**
The advantages of CCTA compared with coronary angiography are that it is less invasive, it can capture thousands of images of a beating heart in seconds, and it may also be relatively less expensive. However 64-slice CCTA requires an injection of iodine-containing contrast and has been regarded as a moderate to high radiation diagnostic technique (12 to 15 mSv), although recent technical advances are improving radiation efficiency considerably. Further disadvantages of 64-slice CT coronary angiography include; poor correlation with coronary angiography in calcified vessels as extensive calcification obscures imaging of coronary arteries, poor correlation with coronary angiography for quantifying stenosis severity when > 50% and in vessels < 2 mm, no functional assessment of myocardial ischaemia and the potential for motion artifacts due to beating of the heart.

**Evidence for Diagnostic Efficacy**
For the diagnosis of CAD, five systematic reviews of 64-slice CCTA reported higher sensitivities (ranging from 96% to 99%) and specificities (ranging from 88% to 97%) compared with the non-invasive tests of stress ECHO, stress myocardial perfusion scintigraphy using single photon emission computed tomography (SPECT), stress MR perfusion imaging and stress MR wall motion abnormalities. There is evidence from short term diagnostic economic models that for patients with a low to moderate pre-test likelihood of CAD, 64-slice CCTA (with or without prior exercise ECG) as the initial investigation is cost-effective compared to invasive coronary angiography alone.

**Evidence for Risks**
The NICE guideline reports on a study that estimated the life attributable risk (LAR) of cancer incidence associated with radiation exposure from 64-slice CCTA. These LARs varied fivefold depending on age and gender, from 1 in 143 for a 20 year old woman to 1 in 3261 for an 80 year old man. The effective dose of radiation from a single scan was reported as a range from 9 to 29 mSv.

**Economic Evaluations**
Of the six economic evaluations included in evidence reviewed for this guideline, two addressed CCTA. Neither one specified whether they applied to stable or acute chest pain. One compared exercise ECG, dobutamine stress ECHO, dobutamine stress MRI, electron beam CT with calcium scoring and multislice CT coronary angiography as initial diagnostic tests, where only those patients with a positive or indeterminate test result would subsequently undergo invasive coronary angiography (Dewey 2007). Based on this analysis, multislice CT coronary angiography clearly dominates exercise ECG, stress ECHO, stress MRI and calcium scoring with electron beam CT as initial diagnostic strategies for CAD at all levels of disease prevalence modelled. This model
did not include any costs for harms of radiation exposure or for evaluation of incidental findings.

The other economic analysis compared 64-slice CCTA compared with exercise ECG, myocardial perfusion scintigraphy with SPECT and invasive coronary angiography in the investigation of CAD (Mowatt 2008). The analysis found that 64-slice CCTA appears to be superior to myocardial perfusion scintigraphy with SPECT for the diagnosis of CAD in all clinical dimensions and also in terms of cost. The report concludes that the high sensitivity and negative predictive value of 64-slice CCTA suggest scope for avoiding unnecessary invasive coronary angiography in those referred for investigation but who do not have CAD. Given the small risk of death associated with invasive coronary angiography, 64-slice CCTA might also confer a small immediate survival advantage. Avoidance of unnecessary invasive coronary angiography may result in cost savings, even if positive results require confirmation by invasive coronary angiography. However, at higher CAD prevalence, these cost savings are likely to disappear. This model included the costs of complications arising from the interventions, but did not specifically address the harms of radiation or the additional costs of evaluation of incidental findings.

The NICE guideline development group performed their own economic analysis of a diagnostic strategy that incorporated the use of calcium scoring using 64-slice CCTA as a precursor to full 64-slice CCTA. This was done as a way of minimizing the risk of radiation from 64-slice CCTA, a risk which was not explicitly incorporated into the other models. Results of the base case analysis indicate that for lower risk groups (5% and 20%), the use of calcium scoring as a first line testing strategy is likely to be cost-effective and should be followed by either 64-slice CCTA alone or with additional invasive coronary angiography as a confirmatory 3rd test. In higher risk populations, (CAD prevalence greater than 40%), a strategy of sending all patients directly to invasive coronary angiography is likely to be cost-effective. The model indicates that myocardial perfusion scintigraphy with SPECT is excluded through dominance or extended dominance at every level of CAD prevalence. It also indicates that exercise ECG is only cost-effective as a first line investigation strategy at 5% CAD prevalence, but that even in this instance replacing exercise ECG with calcium scoring is likely to improve effectiveness at a reasonable level of additional cost.

Evidence Source

Institute for Clinical and Economic Review Report

This cost effectiveness analysis evaluated a variety of diagnostic strategies using stress ECHO, CCTA, SPECT and invasive coronary angiography in two scenarios, in the outpatient setting and in the ED assuming either a 30% or 10% prevalence of CAD. All
analyses were performed without considering harm, benefit, or costs of radiation-exposure or incidental findings, although they did incorporate an estimate for the evaluation of pulmonary nodules. “CCTA alone” resulted in about 14% incidental findings and thus required follow-up as compared to 0% to 5% in the other strategies. Strategies including either CCTA or SPECT as the first or only test exposed all patients to radiation, as opposed to 20% to 40% of patients exposed in strategies with stress-ECHO as the first or only test.

**Asymptomatic patients**
Use of CCTA as a screening tool in asymptomatic patients was not evaluated in this report.

**Emergency department patients with chest pain**
When used as triage in the ED, they found that the model “is consistent with other published cost-effectiveness analyses in suggesting that when used as part of a triage strategy for low-to-intermediate risk chest pain patients in the ED, CCTA will allow the more rapid discharge of nearly half of all patients and decrease the number of false negative diagnoses while reducing the number of angiographies compared to the current standard of care. According to the model CCTA is also cost-saving, with about $719 in savings per patient in comparison to SOC [standard of care]. Taking into account the additional follow-up costs for the 14% of patients who undergo CCTA and have incidental findings (approximately $100 per patient receiving CCTA), the costsavings are reduced to approximately $619, but remain in favor of CCTA. However, CCTA does expose every patient to radiation, whereas only about 43% of the patients in SOC are exposed via invasive angiography.”

In 2012, ICER updated this report to incorporate the findings of two large, multicenter randomized clinical trials of CCTA versus standard ED evaluation. “These trials enrolled nearly 2500 patients at 14 sites, and unlike the earlier trial, included patients at intermediate risk of acute coronary syndromes. Findings were very similar between the two studies. CCTA was found to significantly increase the percentage of patients discharged home from the ED relative to standard care, and reduced time in hospital by seven to eight hours on average. There were no deaths at 28 to 30 days in either study, and no statistically-significant differences in rates of major cardiovascular events. In one study, however, patients in the CCTA arm received more downstream diagnostic testing than those receiving standard evaluation; the increased costs from additional testing eliminated any savings from earlier discharge in the CCTA arm, and average total strategy costs were found to be similar between the groups.”

“ICER previously found the evidence on comparative clinical effectiveness to be ‘Comparable’ between CCTA and standard triage care in the ED setting; these recent findings confirm the original rating. The original rating for comparative value was ‘High’,
however, based primarily on evidence of earlier ED discharge. In light of these recent data on increased resource use following CCTA, we [ICER] would recommend changing CCTA’s comparative value rating to ‘Reasonable/Comparable’.

**Outpatients with chest pain**

In the outpatient model, “at a CAD prevalence of 30%, CCTA produces a higher number of true positives and fewer false negatives relative to other 1- or 2-test strategies, and lower diagnostic phase costs than nearly all other tests; at a prevalence of 10%, differences in test performance are diminished but the pattern of costs remains the same. When alternative estimates of CCTA’s diagnostic accuracy are employed, the balance of false-positive and false-negative shifts, but has little impact on comparative cost between the strategies. However, when a more aggressive strategy for management of mild-moderate stenosis is employed, CCTA becomes more costly than several other strategies due to a higher rate of referral for invasive coronary angiography.”

“Considering a lifetime horizon, quality-adjusted life expectancy is quite similar across the strategies, with a difference of only about 2 weeks between the most and least effective strategies. At 30% CAD prevalence, a single-test strategy with CCTA appears to be more effective and less costly than SPECT, and a reasonable value when compared to Stress ECHO (incremental cost-effectiveness ratios of $13,000 to $16,000/QALY). When prevalence is reduced to 10%, however, while cost-effectiveness is similar for CCTA vs. stress ECHO, SPECT is more effective than CCTA at a ratio of approximately $80,000/QALY. A shift from conservative to aggressive management of mild-moderate stenosis affects the lifetime results only marginally, as does the use of alternative estimates of CCTA’s diagnostic accuracy.”

“Because the range of effectiveness results is so narrow, the model is highly sensitive to changes in selected parameters, in particular the costs of the various strategies. For example, at a cost of $248 or less, CCTA would dominate all other strategies, while for CCTA costs of $1,083, $1,916, and $2,749, the cost-effectiveness ratios would be $50,000/QALY, $100,000/QALY, and $150,000/QALY, respectively.”

[**Evidence Source**]

**Overall Summary**

Coronary computed tomographic angiography may be useful to “rule out” obstructive CAD in ED patients with acute chest pain and normal ECGs and initial cardiac enzymes, and in outpatients with stable chest pain in a population with low to intermediate probability of obstructive CAD. Cost-effectiveness analyses show either that CCTA is comparable or less costly than other diagnostic strategies, although for the most part, they did not consider the economic consequences of the harms of radiation.
or further evaluation of incidental findings. However, understanding how CCTA would be used in a clinical practice setting, and whether the cost-effectiveness assumptions are applicable as it would be used in clinical practice, is unclear. Use in other patient populations is not recommended due to unacceptable false positive or false negative results. Use in asymptomatic patients has not been evaluated.

COMMITTEE DELIBERATIONS-EbGS

At its December 6, 2012 meeting, the EbGS discussed whether to include coverage for CCTA for use in the emergency department in patients with lower risk for coronary artery disease, to speed discharge. After discussion the subcommittee did not find evidence of benefit to patients strong enough to outweigh the concerns regarding radiation exposure, overuse of the service, and the lack of clarity of defined pathways for use of this tool.

COMMITTEE DELIBERATIONS-VbBS

The VbBS discussed making no change in the lack of coverage.

HERC DELIBERATIONS

At its August 8, 2013 meeting, the HERC approved the coverage guidance and accepted the VbBS recommendation to make no associated changes to the prioritized list, resulting in continued noncoverage of this procedure for the Oregon Health Plan.

PROCEDURE

Coronary computed tomographic angiography

DIAGNOSES

Coronary artery disease
Chest pain

APPLICABLE CODES

<table>
<thead>
<tr>
<th>CODES</th>
<th>DESCRIPTION</th>
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<td><strong>ICD-9 Diagnosis Codes</strong></td>
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<tr>
<td>410</td>
<td>Acute myocardial infarction</td>
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<tr>
<td>411</td>
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<td><strong>ICD-9 Volume 3 (Procedure Codes)</strong></td>
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<tr>
<td>87.41</td>
<td>Computed axial tomography of the heart</td>
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### CPT Codes

<table>
<thead>
<tr>
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<th>Description</th>
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<tbody>
<tr>
<td>75574</td>
<td>Computed tomographic angiography, heart, coronary arteries and bypass grafts, with contrast, including 3D image post-processing</td>
</tr>
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</table>

### HCPCS Level II Codes

None

Note: Inclusion on this list does not guarantee coverage

Coverage guidance is prepared by the Health Evidence Review Commission (HERC), HERC staff, and subcommittee members. The evidence summary is prepared by the Center for Evidence-based Policy at Oregon Health & Science University (the Center). This document is intended to guide public and private purchasers in Oregon in making informed decisions about health care services.

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